Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
Unlicensed Operation in the TV Broadcast Bands	)	ET Docket No. 04-186
	)	

WHITE SPACES PROPOSAL BY KB ENTERPRISES LLC AND LS TELCOM

KB Enterprises LLC
1315 Massachusetts Avenue SE
Washington, D.C. 20003
United States

Tel: 202 302 0145
Fax: 202 543 9614
Email: Info@KBspectrum.com
Internet: www.KBspectrum.com

LS telcom AG
Im Gewerbegebiet 31-33
D-77839 Lichtenau
Deutschland

Tel: 07227 9535 600
Fax: 07227 9535 605
Email: Info@LStelcom.com
Internet: www.LStelcom.com

4 January, 2010

KB Enterprises and LS telcom

KB Enterprises LLC and LS telcom ("KBE/LS") hereby submit their proposal to become a TV band database administrator based on the Office of Engineering and Technology Public Notice ("PN") inviting proposals from entities seeking to be designated TV band device database managers in the above-captioned proceeding.

KB Enterprises LLC ("KBE") is a Washington, D.C. based consultancy providing telecommunications policy consulting as well as spectrum auction design and software implementation. KBE's founding partner Karen Wrege was the program manager for the conceptualization, design and development of the FCC's Universal Licensing System ("ULS").

LS telcom was founded in 1992, and provides network planning software to operators and spectrum management solutions to national regulators. In the past ten years, the LS telcom group has delivered over $100 million of solutions to regulators on every continent. Today, LS telcom has over 75 national regulatory agencies as its clients throughout the world.

In 2009, KB Enterprises and LS Telcom finalized and announced an agreement to combine their expertise in spectrum management and spectrum auctions to provide tools for efficiently allocating and assigning spectrum.

INTRODUCTION AND SUMMARY

The FCC has asked for entities to submit proposals to operate a database to satisfy the FCC's rules for providing a data repository, a data registration process, a query process and a fee collection process to allow authorized devices to use the television "white spaces" to provide services. To this end, the FCC has asked entities to address five points:

1. The entity possesses the technical expertise and real world experience to administer a TV and database and can prove it can operate the database for the five-year term established in the FCC rules;
2. The scope of database functions to be performed, and how data might be synchronized between multiple TV band database administrators, if multiple administrators are authorized;
3. The architecture and description of the functions of the system;
4. A description of data transfer mechanisms; and
5. A description of how TV band devices will communicate with the database, including security methods.

The KBE/LS team is uniquely qualified to provide these services and administer a TV band database. KBE founder Karen Wrege was the program manager for the conceptualization, design and development of the FCC's Universal Licensing System, and both principals have expert knowledge of the FCC licensing and rulemaking processes. While KBE's experience in this area is significant, the company founders were interested in not recreating the wheel when developing the TV band database. Instead, they investigated the world market for the leading off-the-shelf spectrum

management software provider to partner with who could use its existing tool set and customize it to fully meet the FCC requirements. LS telcom has been in business since 1992, with their origins in broadcast network planning and now provides spectrum management database tools in over 75 countries around the world. Both firms are well established and have a proven track record of system and database development and management.

Beginning in 1992, LS telcom has developed a complete suite of tools for Spectrum Management which is used all over the world by public, military and private regulators for the purpose of granting Spectrum access to its customers on a open and non discriminatory basis while ensuring also the efficient and economic use of the limited resource spectrum. With the LS suite of technology, all necessary elements to build, operate and further refine the database are available as COTS to meet the FCC's stated requirements. The KB/LS team has a strong group of experienced analysts, developers and engineers capable providing the best solution for the US market from these components.

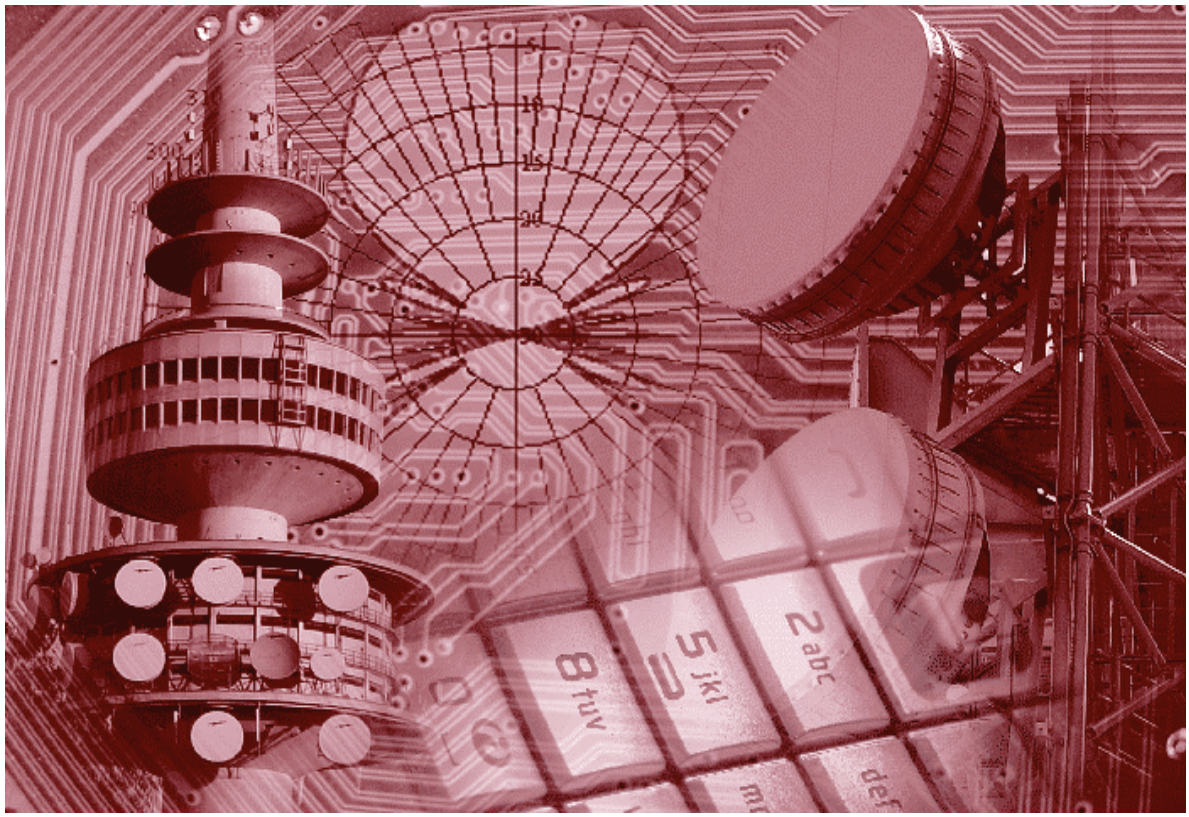
The KBE/LS team plans to perform the entire set of database functions required by the FCC including data repository functions, data registration, calculation and query functions, and fee collection, and will work with other TV band database administrators to synchronize data on a regular basis.

In our technical proposal, attached, we provide details on the architecture, functions and methods employed in the system.

TV Band Database Proposal
KB Enterprises and LS telcom

Prepared for the FCC

4 January 2010



KB Enterprises LLC
1315 Massachusetts Avenue SE
Washington, D.C. 20003
United States

Tel: 202 253 4601
Fax: 202 543 9614
Email: Info@KBspectrum.com
Internet: www.KBspectrum.com

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D-77839 Lichtenau
Deutschland

Tel: 07227 9535 600
Fax: 07227 9535 605
Email: Info@LStelcom.com
Internet: www.LStelcom.com

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1 About KBE and LS telcom

1.1 Introduction

KB Enterprises LLC and LS telcom ("KBE/LS") hereby submit their comments on the Office of Engineering and Technology Public Notice ("PN") inviting proposals from entities seeking to be designated TV band device database managers. The KBE/LS team have existing solutions that meet many of the requirements set forth by the FCC, and have the expertise, skills and ability to further modify and enhance its existing software to implement the proscribed TV Band Database in the United States. In the following sections we will lay out our qualifications and details of our solution.

1.2 KBE

KB Enterprises LLC ("KBE") is a consultancy providing telecommunications policy consulting as well as spectrum auction design and software implementation. KBE's founding partners Karen Wrege and Brett Tarnutzer together have over 36 years of experience in telecommunications policy and spectrum software systems development. Their experience in telecommunications began within the FCC and more recently they have worked for wireless telecommunications companies and government regulators around the world providing software solutions and tools for companies and regulators for spectrum assignment. Notably, KBE's founding partner Karen Wrege was the program manager of the conceptualization, design and development of the FCC's Universal Licensing System ("ULS"), and has a deep and rich understanding of the FCC licensing data and fee collection processes and systems. KBE has expertise and experience managing complex database development projects in and for the Federal sector and has significant experience merging data from multiple, disparate data sources into a single database. While KBE's experience in this area is significant, the company founders were interested in not recreating the wheel when developing the TV band database. Instead, they investigated the world market for the leading off-the-shelf spectrum management software provider to partner with who could use its existing tool set and customize it to fully meet the FCC requirements.

1.3 LS telcom

LS telcom AG (LS telcom) is the world's leading vendor of spectrum management solutions supporting more than 75 countries worldwide. LS telcom was founded in 1992 as an engineering company focusing on radio network planning. Its founders, Dr. Manfred Lebherz and Dr. Georg Schöne, both worked in the Institute for Microwave Technology (IHE) at the University of Karlsruhe/Germany for several years, where they developed wave propagation models and radar measurement technologies.

LS telcom is the only company that offers a complete portfolio of software, strategic consulting, training and engineering services addressing the efficient use of radio frequency spectrum and ensuring the most optimal operation of radio communication services. What started as a niche market engineering company is now a highly professional group of companies operating on a worldwide scale in consultancy, system integration and software supply. Over the past 18 years, LS telcom has grown to over 118 employees in 6 countries. The LS telcom Group is today comprised of LS telcom AG Germany, LS telcom SAS France (former Spectrum Management Division of CTS International), LS telcom Limited Canada (Spectrocan), LS telcom Hungary, LS telcom Oman, and LS telcom of South Africa.

As a company dedicated to the supply of spectrum economy solutions and as a manufacturer of spectrum management software, LS telcom has become internationally recognized in radio network planning and spectrum management, and has successfully implemented spectrum management systems for numerous regulating organizations in countries with extremely high telecommunication standards.

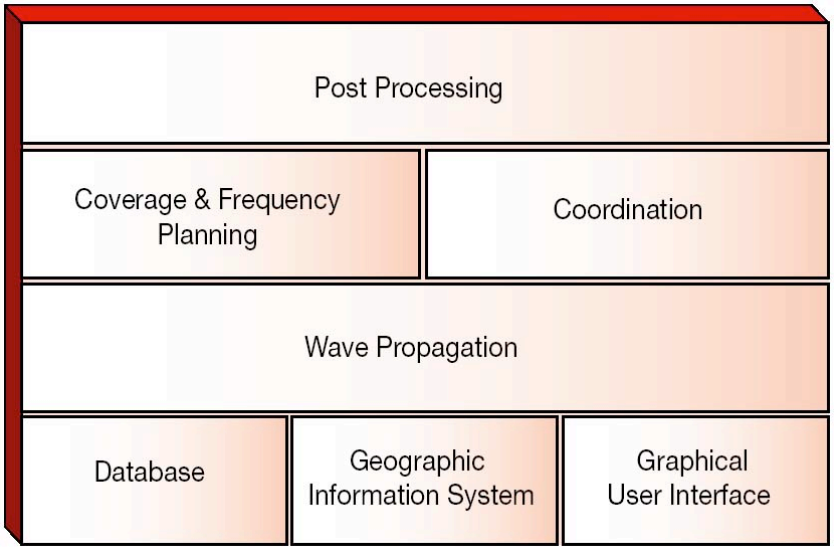
LS telcom operates on the basic premise that, beyond the delivery of advanced automated systems, we also deliver appropriate operational expertise, technical support, and training. This philosophy has been the cornerstone of its success regardless of project complexity, scope, and size. LS telcom is a strong proponent of long-term human resource development programs to ensure its clients are provided with expert staff for the length of the project. LS telcom's commitment to knowledge transfer is reflected in the various telecommunications institutions they are active in (as listed below), as well as on numerous training projects and seminars that they conduct for their staff and clients.

With its global operations and partnerships, LS telcom has a detailed knowledge of the local Information and Communications Technology (ICT) environment as well as the processes and procedures required for successful consultation with local stakeholders. LS telcom integrates their participation in a number of international organizations and study groups into their approach, including:

- Membership in the ITU Radio Communications Sector and the ITU Development Sector;
- Membership in the Telecommunications Executive Management Institute of Canada (TEMIC) and the Inter-American Telecommunication Commission (CITEL)
- Membership in the Broadcast Mobile Convergence Forum (BMCO), and
- Close partnerships with many recognized research and development institutes and universities, e.g. German Institute of Broadcasting (IRT), Canadian Research Center (CRC)

Since it was founded in 1992, LS telcom has provided network planning software to operators and spectrum management solutions to national regulators. In the past ten years, the LS telcom group has delivered over $100 million of solutions to regulators on every continent. Today, LS telcom has over 75 national regulatory agencies as its clients throughout the world.

Over the years, LS telcom's team has invested hundreds of man-years of development in spectrum management systems and radio network planning tools. Our Spectrum Management System SPECTRAplus is based on the best practices and it is utilized by regulators throughout the world, and has a proven track record. As shown in the following figure, the SPECTRAplus system goes well beyond application processing and truly embodies all of the elements of a complete and modern SMS system.



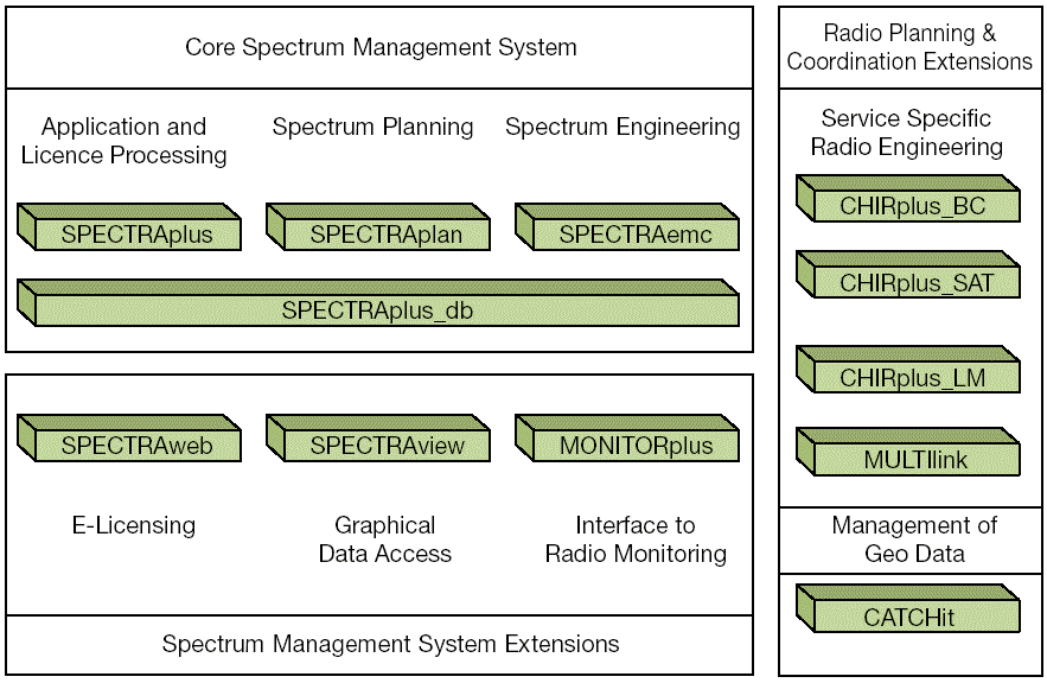
Features of the SPECTRA System

The SPECTRA system was designed in a modular fashion in order to create a solution that can be tailored to each individual customer. In the case of the TV bands database, only the relevant modules will be deployed, keeping the system lean, but allowing for the easy integration of other modules in the future if rules, requirements or desired features change.

1.4 Technical and commercial experience

KBE/LS together possess the technical expertise and real world experience necessary to develop and operate a TV band database, including the ability to sustain operations for the five-year requirement.

As shown in the figure below, during the past two decades, LS telcom has developed a complete suite of tools for spectrum management that are used all over the world by public, military and private regulators for the purpose of granting spectrum access to their customers on an open and non-discriminatory basis while ensuring the efficient and economic use of the limited resource.



SPECTRA System Modules

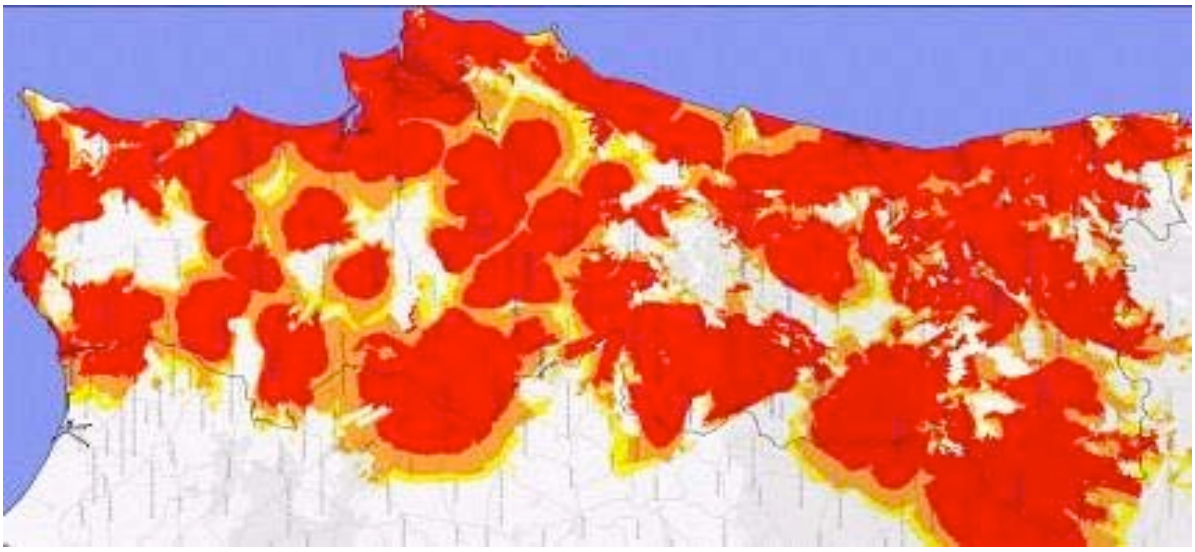
A summary of the existing capabilities and modules of the system can be found at the end of this proposal. The summary shows that all necessary elements to build, operate and further refine the TV bands database are already available as COTS products offered by LS telcom.

The LS telcom group's strong team of analysts, developers and engineers has the proven knowledge and expertise to develop and operate a secure, accurate and accessible TV bands database in the United States.

1.5 Our vision of the future of spectrum management

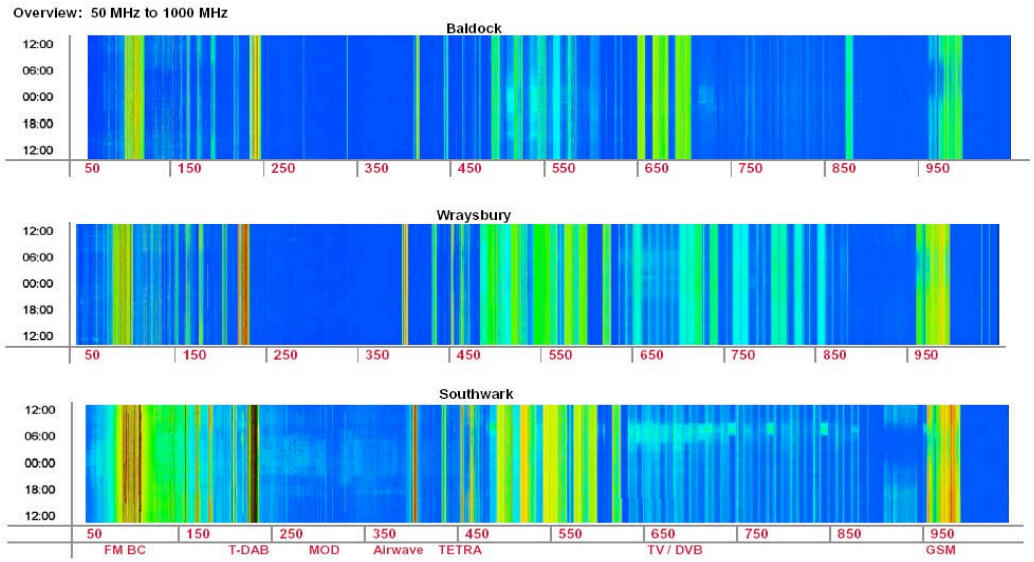
With its decision to allow the use of "white spaces" in the TV band, the FCC has opened the door to a breathtaking future for spectrum distribution. Through the networking of communication devices, information services (databases), calculation services and interference monitoring (as separate units or embedded in the communication devices), a completely new dimension of possibilities is available. KBE/LS telcom is excited to contribute its experience in the traditional Spectrum Management and implementation of complex, web-based database applications to this future technology. The white spaces proceeding being undertaken by the FCC is the first step to a new paradigm for future spectrum management.

The key to using white spaces is to detect unused spectrum. This can be conceived of in a number of ways, either in the **geographical dimension**, as shown in the following example from an LS telcom analysis of the digital services in Portugal:



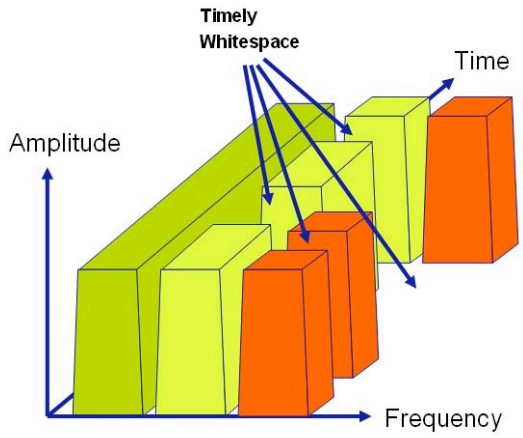
The coverage of a DTV scenario in Portugal (differing signal strength indicated by red, orange and yellow) and the resulting white spaces.

In the **frequency dimension**, as illustrated in an analysis for Ofcom for locations within the UK:



A comparative view of spectrum usage in urban (lower plot), suburban (middle plot) and rural (upper plot) areas with blue representing no signal and red representing a strong signal. The plots show spectrum occupancy over a 24-hour period.

Or in the **time dimension**, as shown below, which shows the time dependent usage of wireless microphones:



Using white spaces in the time dimension

Once identified, devices can make use of these otherwise unused white spaces.

2 THE KBE/LS TV BANDS DATABASE

2.1 Required elements and payment schemes

The KBE/LS team is committed to fulfill all of the elements of the TV band database requirements including, creating a fully secure and reliable database to act as a data repository, performing calculations to determine available channels and registering fixed unlicensed devices and licensed services not listed in the FCC's databases.

The KB/LS team is proposing to charge TV band devices a fee for initial registration with the database with the option of annual or bi-annual renewal fees. We propose that the fees would be collected in one of two ways. First, vendors could pre-register devices in bulk, activating multiple serial numbers with a payment to the TV band database by wire transfer or credit/debit card. Second, users could register a single device through a web portal or the device itself and activate its serial number with a payment to the TV band database by wire transfer or credit/debit card.

We understand that the FCC feels it is not appropriate to charge operators of licensed services to register their operations as protected services in the database and we do not propose to do so. We propose to charge unlicensed entities filing with the database for protection (e.g., cable headends and TV translator/low power TV station receivers) a fee to register the equipment or to make modifications to their registration, following the FCC's application fee model. We will give these filing entities the option of filing and paying in a batch process, or interactively via a web interface. Finally, another category of registrants may be network operators who wish to register all of their network equipment with the TV band database. We envision creating a frame agreement for registrations that encompass a complete network and would allow the network operator to pay by check or wire transfer. All access to the database and fees charged for the database will be on a non-discriminatory basis.

Our team possesses the skills and experience to implement the fee collection system. KBE founder Karen Wrege was responsible for the implementation of the current Universal Licensing System at the FCC where batch and interactive filing of applications and payments

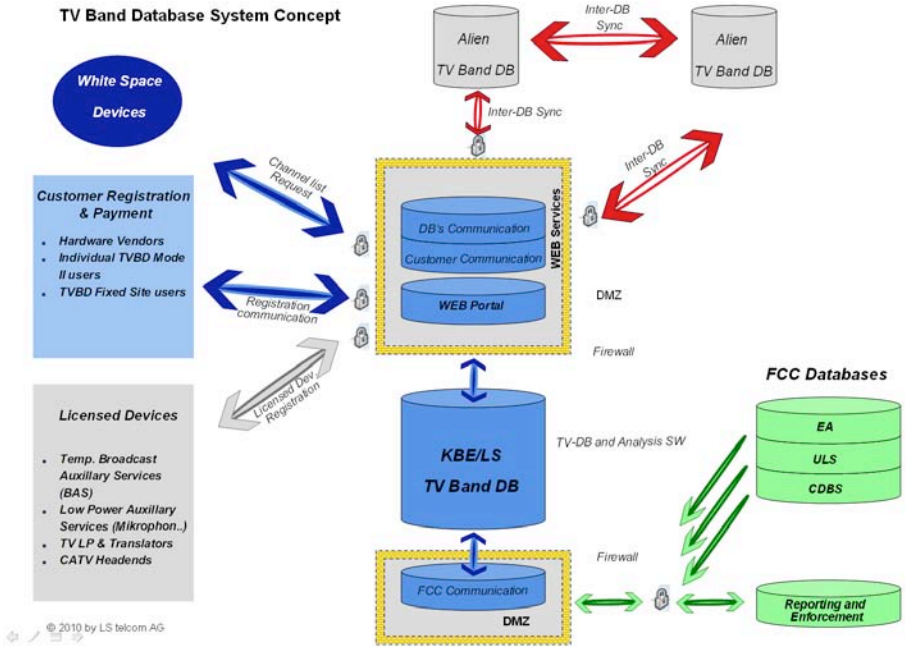
were introduced for all wireless services in 2001. In addition, LS telcom's existing application processing system has collections based software to compute and collect fees electronically and to match manually filed fees to electronically filed applications.

In summary, we envision providing flexible payment options, including:

- Checks
- Wire transfer
- Credit/debit cards
- Payment services (Paypal, Google payments, etc.)

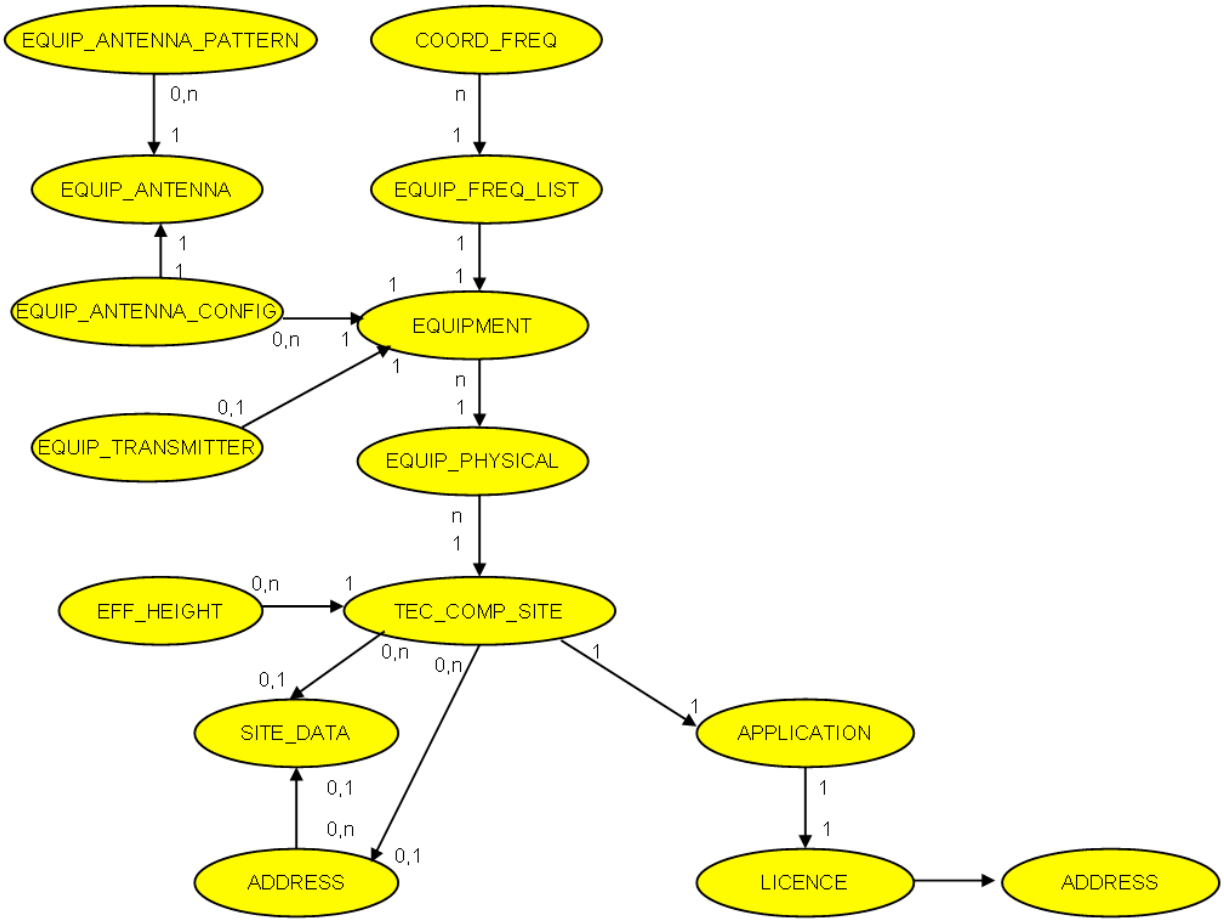
2.2 The KBE/LS TV band database structure

As mentioned above, the KBE/LS TV band database functions and structure will support all of the needs and requirements set forth in the FCC rules. The following diagram shows the high level concept of the primary entities and data streams included in the database.



2.2.1 Structure of the database

LS telcom has developed a database structure that is optimized by radio service. The figure below illustrates the high-level core data storage map for broadcast licenses.



The database is designed to contain technical, administrative, coordination, payment and status information for each entity. The database also includes workflow processing and maintains complete histories for registration and renewal status.

2.3 The KBE/LS TV band database functions

The major tasks that will be undertaken by the Band Database System are outlined below:

2.3.1 FCC Data Import and Update

The following data will be initially imported and instantly updated from various FCC databases:

- TV transmitters (full service and low power) from CBDS
- Public Land Mobile Radio services and Commercial Mobile Radio Services from ULS
- Regions served by the Offshore Radiotelephone Service from ULS
- Fixed Broadcast Auxiliary Point-to-Point Services from ULS

This data will serve as the base for the analysis of available channels, and will be augmented by additional data described below. The data will be retrieved from the FCC on a nightly basis, and the TV band databases would benefit from the FCC providing a modification file as part of its nightly batch processing to append the database on a nightly basis with the updated information.

2.3.2 Licensed, non registered devices

The TV band database will support the registration of devices that are licensed by FCC but are not available in the FCC databases via a web portal. These include:

- Temporary Broadcast Auxiliary Devices (BAS)
- Low Power Auxiliary Devices like portable microphones
- Low Power TV stations and TV translators
- Cable TV head ends outside the protection area of the related TV site

The database will capture the relevant data elements based on the specific requirements set forth in the FCC rules and will include real-time edit checks to ensure data accuracy.

2.3.3 Data synchronization with other TV band databases

We understand the FCC will leave the details of data synchronization among multiple TV band databases up to the administrators. It is our belief that in order to provide accurate data to TV band devices and adequately protect incumbent users, it is necessary for the TV band databases to have a defined handshake and timing schedule in place.

2.3.4 TV Band device access to database

Unlicensed TV band devices of a fixed nature or portable ones operating in Mode II need to register with a TV band database to get information about free channels. To ensure TV band database access only by type-accepted equipment, basic information (FCC ID and serial number) will be stored during the registration process, when the vendor, producer or owner initially registers the device with the database. When the device accesses the database to query for available channels, it will transmit this information again for verification of registration. This will serve as a security check. At that point, for mode II devices the device's coordinates (latitude and longitude) will be submitted to the database to query for available channels. For fixed devices, the user's name and contact information must be submitted and will reside in the database.

2.3.5 Reporting to FCC

The database will allow the FCC to access information about registered devices in order to address potential sources of interference. As part of the TV band database system, KBE/LS will implement a password protected FCC interface that will allow authorized FCC users to query the database for available information by defined search criteria. The final functionality of this section will be agreed upon with the FCC.

2.3.6 Enforcement of FCC decision to de-authorize a device

The FCC will have the ability to specify any device, make, or group of serial numbers within a specific make, as "de-authorized," such that it receives the message "no channels available" when reconnecting.

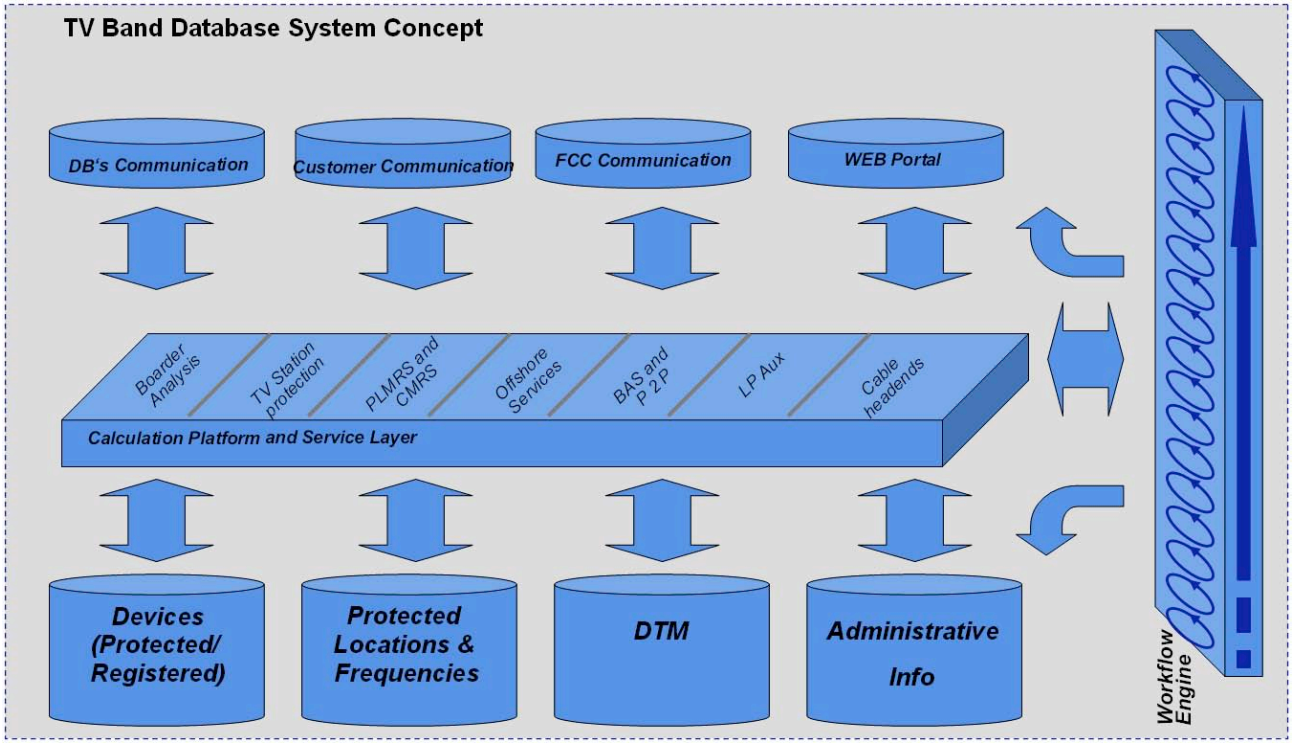
2.3.7 TV band database functional units

The TV band database consists of several functional units:

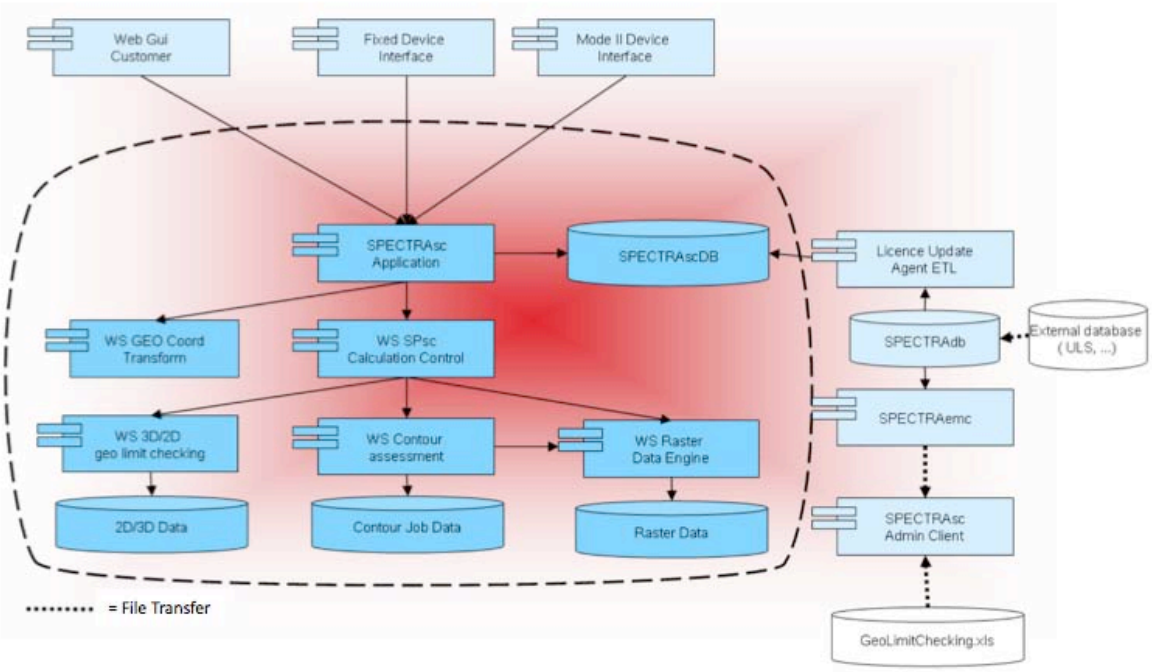
- The database tables for devices, frequencies, protected areas, status and payments
- The workflow engine that controlling all processes, including registration and querying
- The analysis tools for determining open channels, taking into account:
    - Border protection (distance criteria, frequency band)
    - TV station protection (according to FCC contours @ frequency)
    - PLMRS and CMRS protection (13 City centers plus registered auxiliary locations @ frequency)
    - Offshore radio telephony service protection (contours @ frequency)
    - BAS and broadcast point-to-point services: (angle and distance @ frequency)
    - Low power auxiliary device protection (distance @ frequency)
    - Cable head ends (distance, angle, frequency)
- The interfaces for providing information to:
    - TV band devices (available frequency list @ location and device type)
    - Other TV band databases to update registration information concerning licensed devices in operation
    - The FCC, including status information and registration information for fixed TV band devices and Mode II devices
- The interface to retrieve information (new records and updates) from other TV band databases and from the FCC databases on a regular basis.
- The web portal for:
    - Device notification
    - Manual database queries

- Individual payments
- Registration of licensed services
- Specific database queries by FCC

The following figure shows the general system concept:



Given LS telcom's long and distinguished history developing spectrum management systems, this functionality does not have to be developed from scratch, but is available in existing LS telcom products. A short illustration of the LS telcom Special Coordination Tool SPECTRA SC, is shown here:



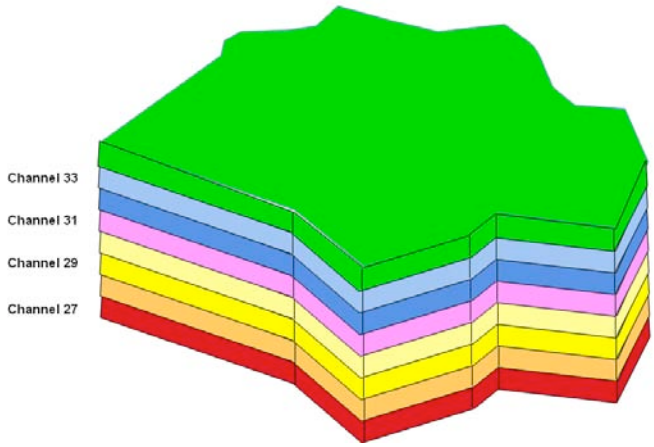
SPECTRAsc coordination tool

2.4 Protection of TV stations and other services

In order to give rapid responses for any channel list request, the system will operate in two steps: First, an analysis unit will calculate the impact of any new registration or modification, and second, a query unit will run a compatibility analysis to check channel availability at a specific location. The concept is based on a layering of the channels within a region (or fractions of a channel, if in the future this is more granularly defined) as shown below. Initially, all channel layers are empty. The following constraints are applied for every layer:

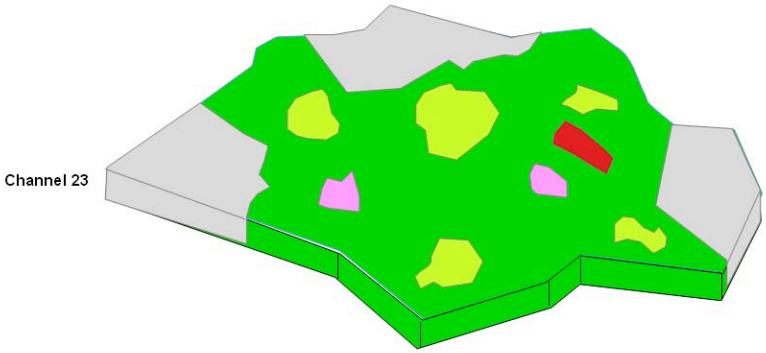
- Border protection (distance criteria, frequency band)
- TV station protection (according to FCC contours @ frequency)
- PLMRS and CMRS protection (13 City centers plus registered auxiliary locations @ Frequency)
- Offshore radio telephony service protection (contours @ frequency)

- BAS and broadcast point-to-point services: (angle and distance @ frequency)
- Low power auxiliary device protection (distance @ frequency)
- Cable head ends (distance, angle, frequency)



Initial band scenario with no constraints applied: all frequencies available everywhere.

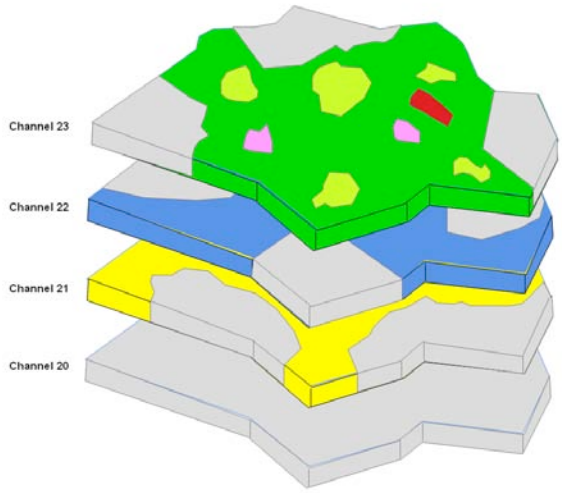
For a single channel, this could lead to a result as shown below: The green spaces are still usable for granting access, while the colored spaces are blocked.



Constraints are applied for one device class at channel 23

As a result, the database will contain detailed contour information to be considered for all available channels or sub-channels. It is then possible to quickly check for the availability of a channel at a specific location. This contour information will be applied all of the various kinds of

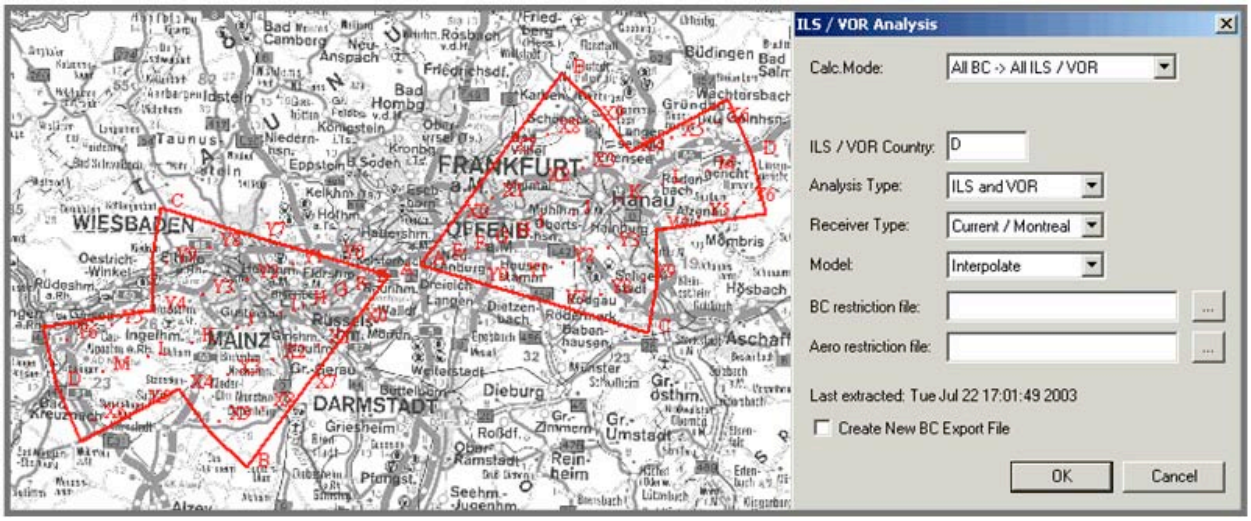
devices including low power uses in adjacent channels. The analysis unit will continually examine new entries and modifications to the database and determine their impact on the actual situation in a specific channel /device class layer.



Final band scenario with all constraints applied: Only specific channels available at certain locations

2.4.1 Protection of contour based boundaries: General capabilities

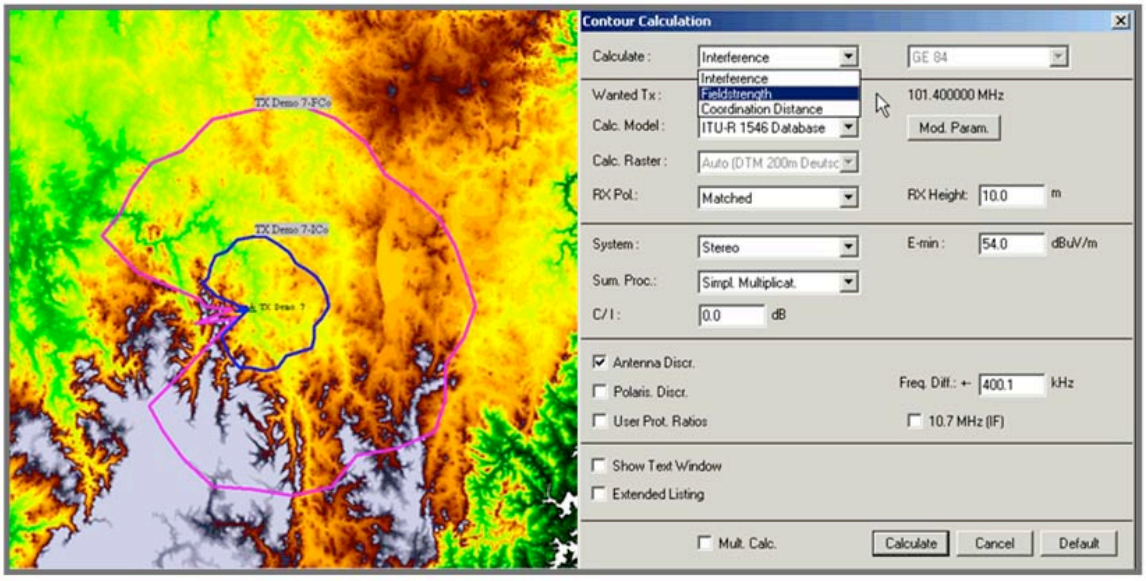
The system is tailored to protect services and devices based on contour approaches using given contour structures, e.g. provided as polygons. The following figure shows protection zones for flight paths in the proximity of civil airports.



Protection of a glide path in the proximity of an airport

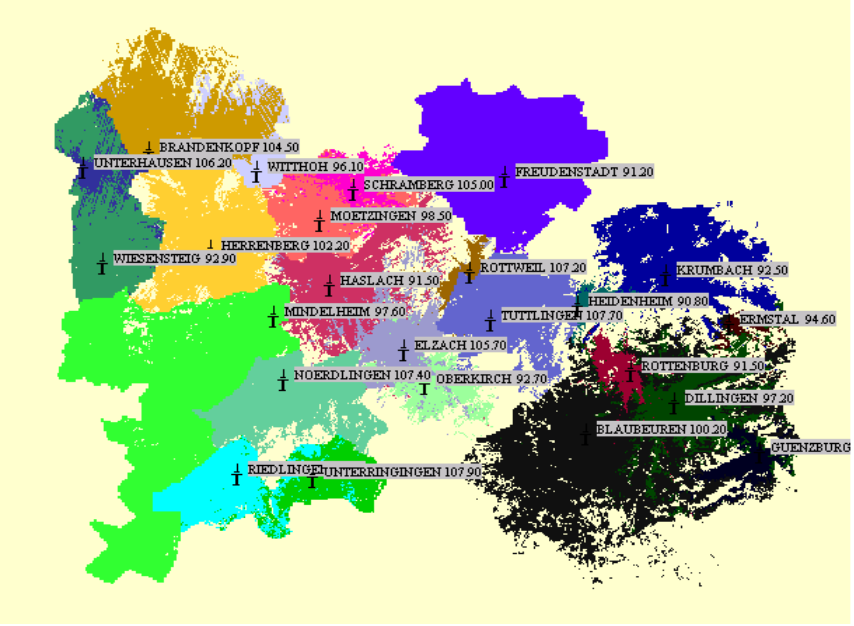
These contours may be very different in nature and the LS system is capable of combining constraints (*e.g.* use a specific contour at one frequency while using another contour or no contour at all at others.) The system is programmable, allowing it to easily adapt to future rule changes.

The system is able to calculate field strength contours according to the R6602 curves, which are already embedded in the system. In addition, it has a powerful field strength and interference analysis engine included for many other kinds of propagation models. It is able to analyze co- and adjacent- channel interference and also desensitization and intermodulation interference from and to more distant channels. Using the system, contour calculations can be easily be analyzed for interference limited paths or for noise limited paths.

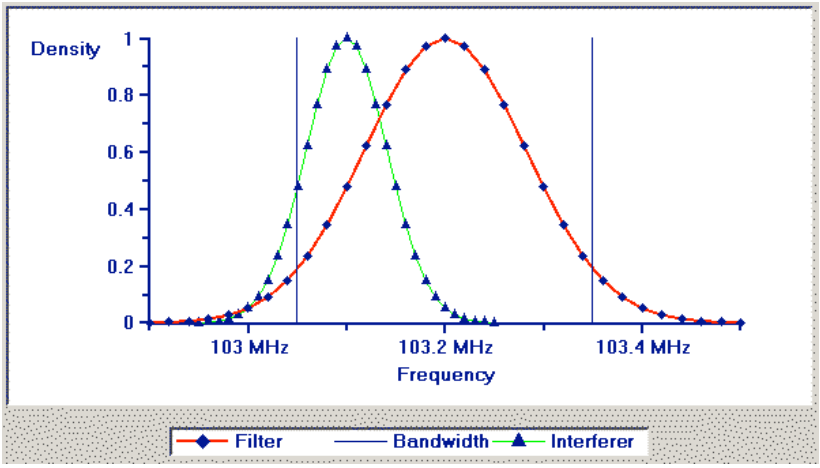


Analysis and consideration of noise or interference contours for a broadcast transmitter

Furthermore, the system has embedded modules for detailed terrain based analysis using high level prediction models for field strength prediction and frequency dependent rejection (FDR) for interference consideration in neighboring channel scenarios.

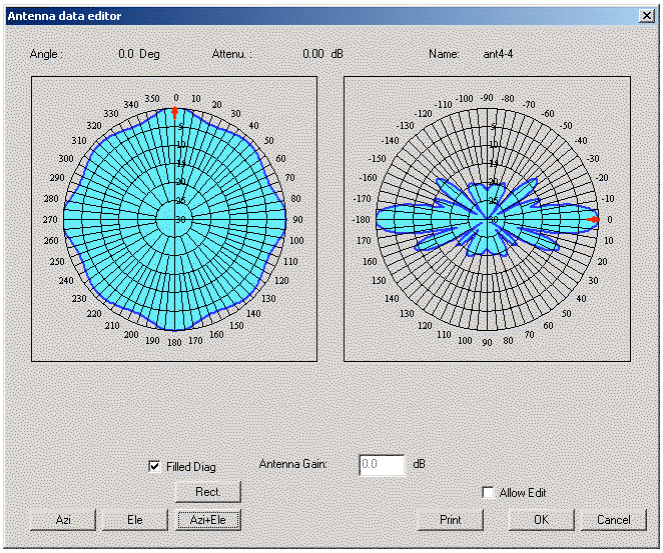


Best server consideration based on a detailed analysis with a model using topo and morpho

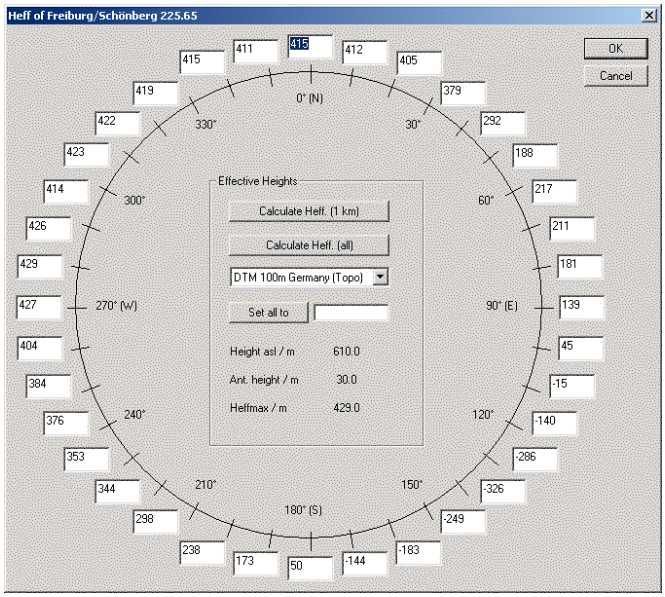


Analysis of interference from neighboring channels using FDR

In order to get the most accurate results, the system stores all propagation and interference relevant information like Antenna Pattern, Filter Curves, Emission Masks and uses either individual figures for a specific device or general data which has been standardized for a group of devices or a whole service. For more general considerations and especially for the fast analysis of contour scenarios, the system can also store and make use of effective heights and effective terrain roughness.



Antenna Pattern in horizontal and vertical plane; also 3d diagrams may be stored and used



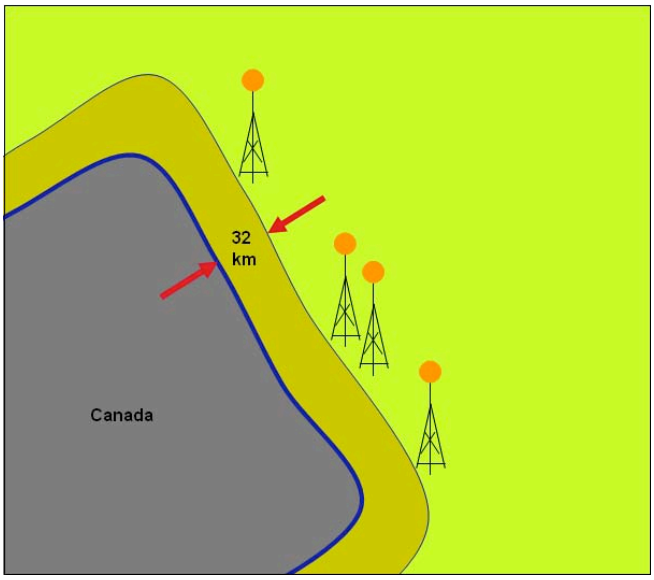
Effective heights for a TV transmitter

2.4.2 Protection of contour based boundaries: Specific tasks

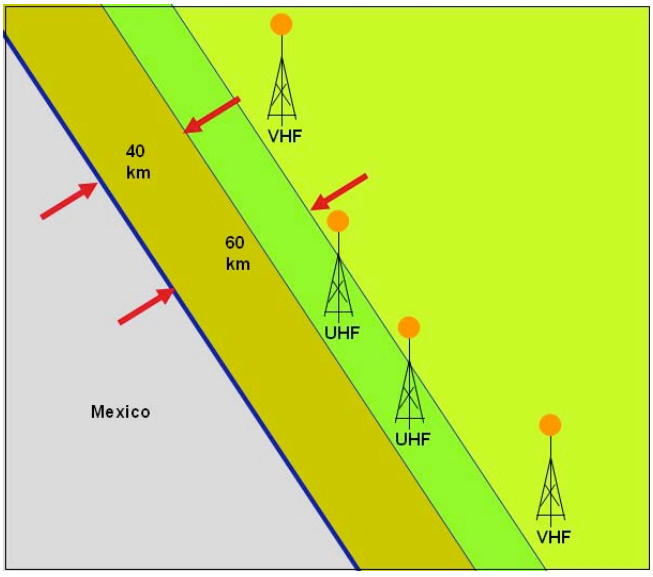
The next section gives detailed information on the analysis methods applied in the TV bands database.

2.4.2.1 Protection of Borders

The system considers the following border scenarios:



No TVBD's in 32 km distance to the Canadian border

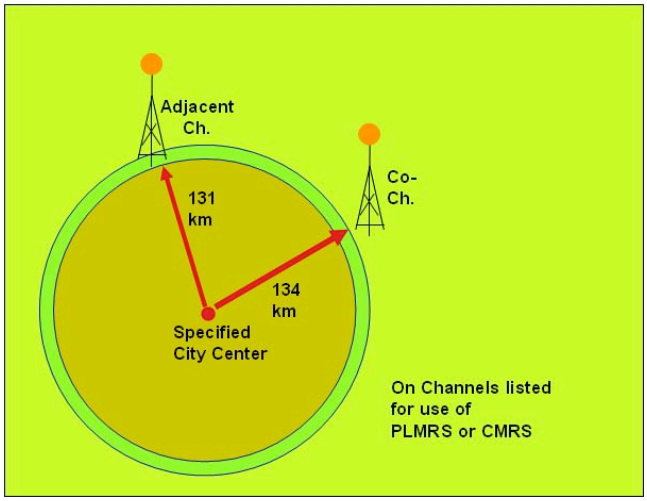


No UHF TVBD's in 40 km and no VHF TVBD's in 60 km distance to the Mexican border

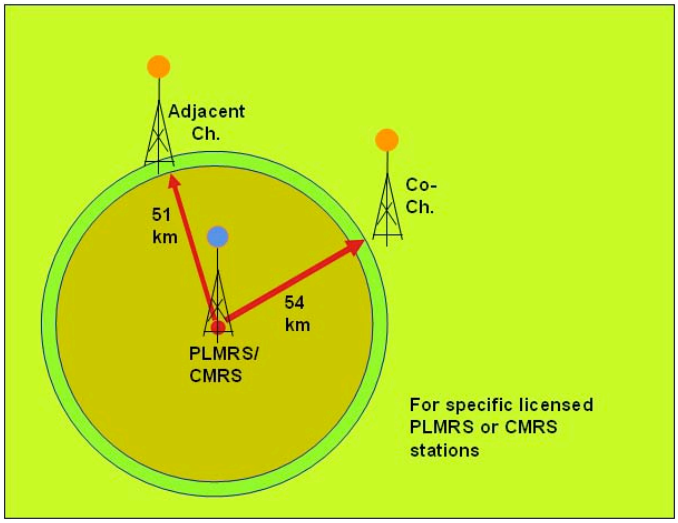
The borders are stored as polygons in the database, and the distant in-country lines are precompiled in the database allowing for fast analysis.

2.4.2.2 Protection of PLMRS and CMRS services

Public and commercial mobile radio services must be protected at specific channels in 13 major cities in the US. These locations and the relevant protection circles at 131 and 134 km are stored for comparison in the spatial sector of the database.



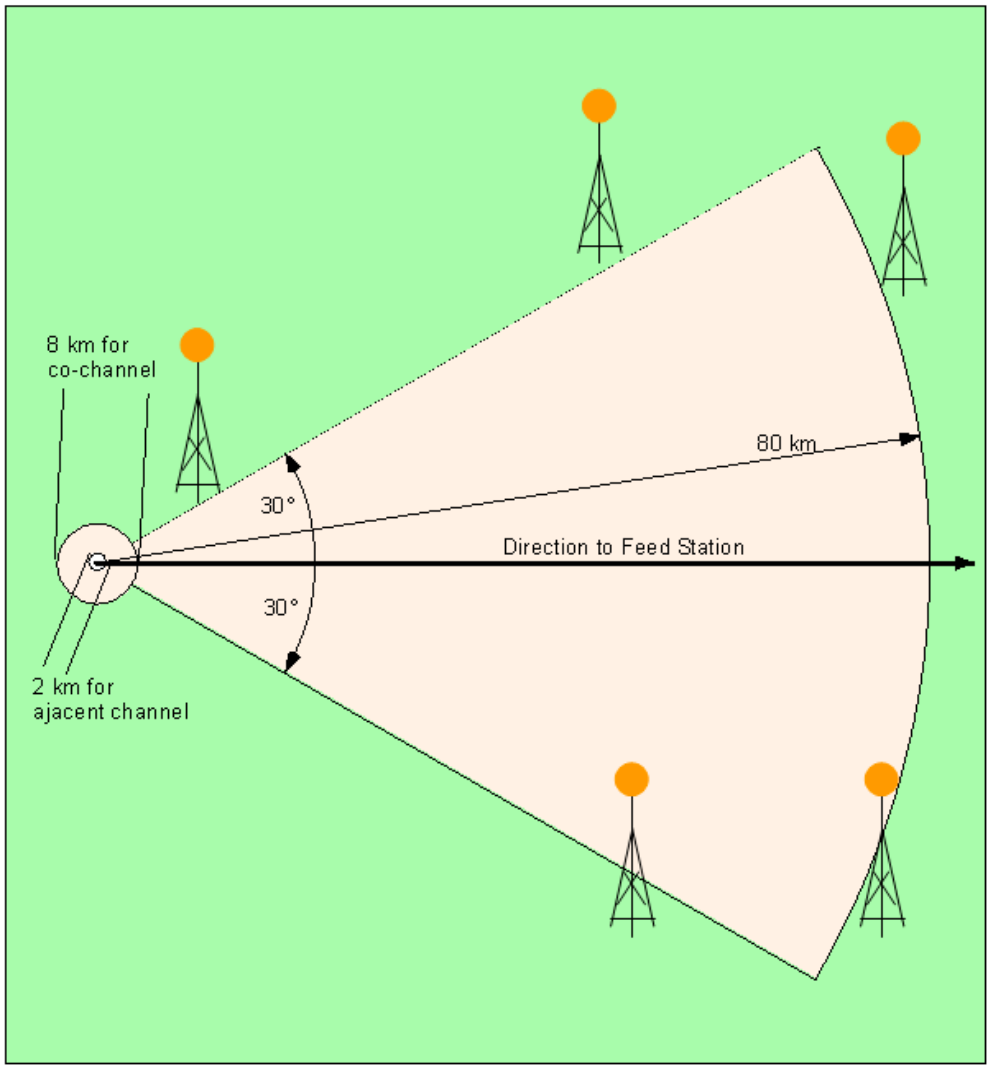
Protection of PLMRS and CMRS in major city centres; also protection of Ch.37



Protection of individually licensed PLMRS and CMRS

2.4.2.3 Protection of Cable TV head-ends, translator receivers and permanent BAS

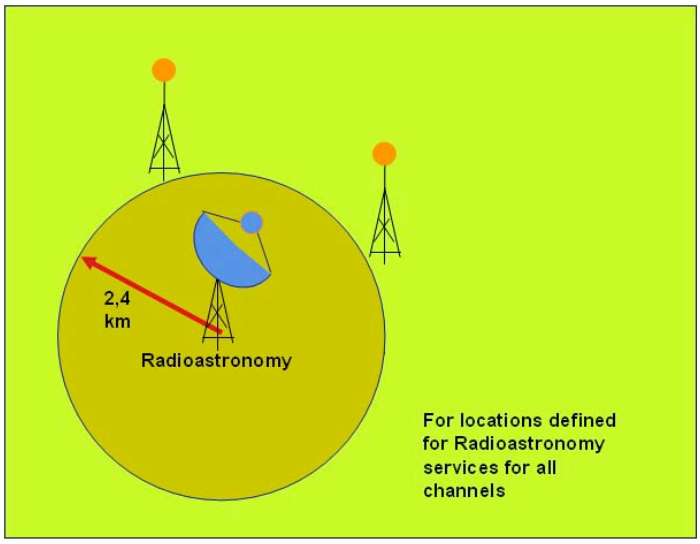
Cable TV head-ends, translators and permanent BAS sites have a relation to a specific feed station from where they receive their signals. If they are located outside the coverage contour of the feed site, a keyhole protection, as explained in figure below, is applied. The keyhole is processed once a station is registered in the database and will be considered when compiling empty channels.



Protection of BAS, CATV head-ends and translator sites

2.4.2.4 Protection of Radio-Astronomy services

As Radio-Astronomy sites require high protection against man-made noise, it is important to protect theses sites. Therefore, a of 2.4 km protection circle will be applied.



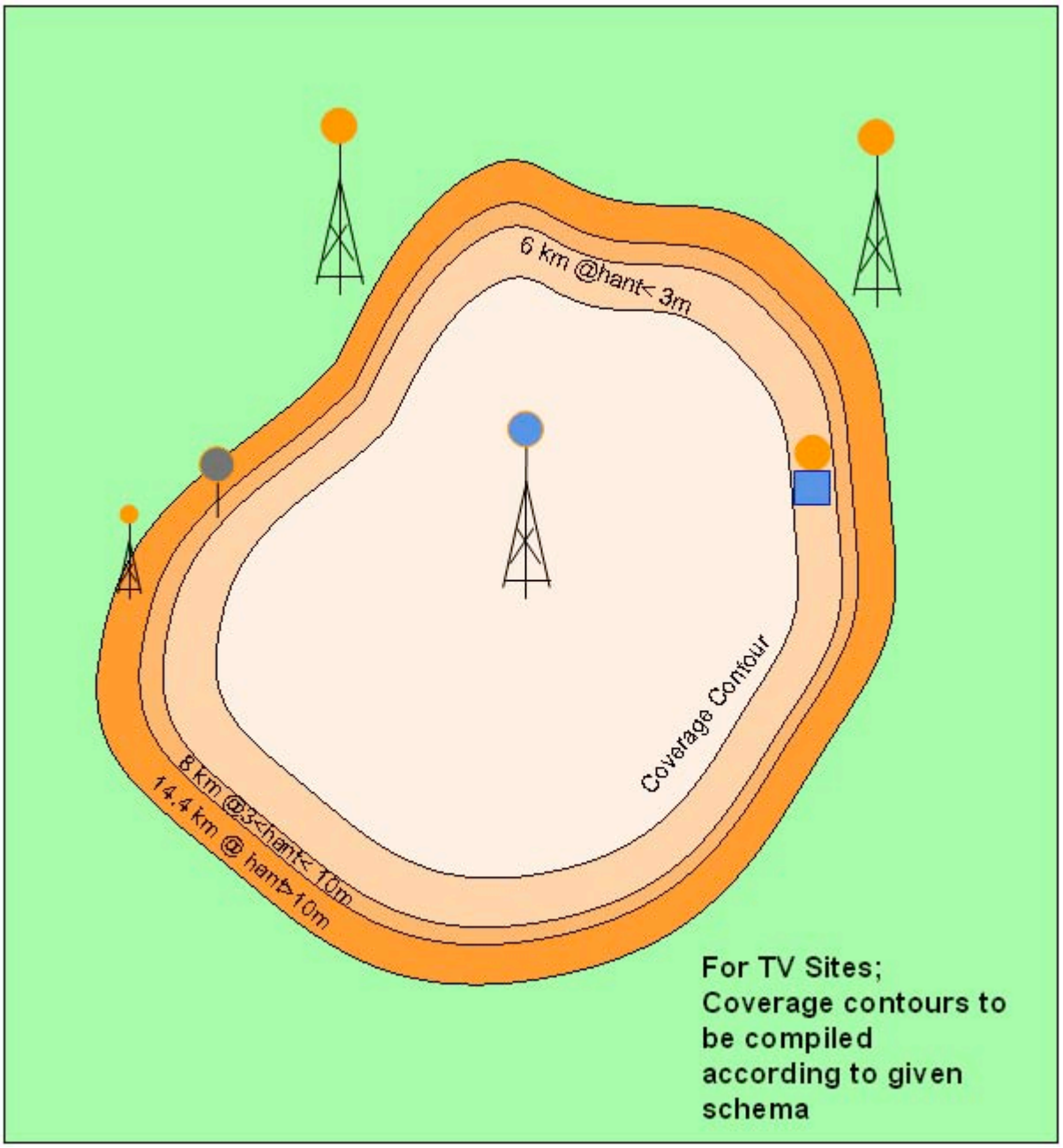
Protection of Radio-Astronomy Services

2.4.2.5 Protection of TV services

For TV services, the system calculates the coverage contours according to the table given below. Therefore all facilities are included in the system and compilation takes only fractions of a second.

Type of station	Protected contour		
	Channel	Contour (dBu)	Propagation curve
Analog: Class A TV, LPTV, translator and booster	Low VHF (2-6)	47	F(50,50)
	High VHF (7-13)	56	F(50,50)
	UHF (14-69)	64	F(50,50)
Digital: Full service TV, Class A TV, LPTV, translator and booster	Low VHF (2-6)	28	F(50,90)
	High VHF (7-13)	36	F(50,90)
	UHF (14-51)	41	F(50,90)

Based on these contours, the following protection considerations are applied:



Protection of TV stations

2.4.2.6 Protection of Low power devices, including wireless microphones

Registered devices and sites will have a protection zone of 1 km from the site location. These circles will be computed after registration or after receiving data or updates from another TV band database and stored in the protected channel layers.

2.4.2.7 Protection of Off-Shore Telephony services

Off-shore telephony services will be protected along the Gulf of Mexico in the four designated regions. .

2.5 Interfaces

2.5.1 TV band device communication with TV band database

There are two planned interfaces for communication between the TV band devices and the TV band database. The are:

- A web portal where the producer, vendor, or user of the device may register the device for use and pay the fee for database access.
- An interface for the TV band device to register at a given location to get an available channel list. The input and output will be standardized between the database providers and other stakeholders.

2.5.2 Interfaces to the FCC databases

The database will connect with FCC databases to retrieve information no less frequently than daily. As mentioned earlier, we recommend that the FCC create summary files of modifications for the TV band databases to simplify the update process. We envision the FCC putting the files on a file server than can be accessed by the TV band database managers to download the files and update their databases on a daily basis.

2.5.3 Interfaces for other database operators

For communication and data exchange with other TV band databases we will meet and agree on an interface structure. It will be critical to have rapid and efficient updating in order to keep the data accurate and current. One means of doing this is for each database administrator to continually update a secure change log so other TV band databases could access the changes on a real-time basis. In addition, there will also be a need for a full download capability to get the complete status for periodic database validation.

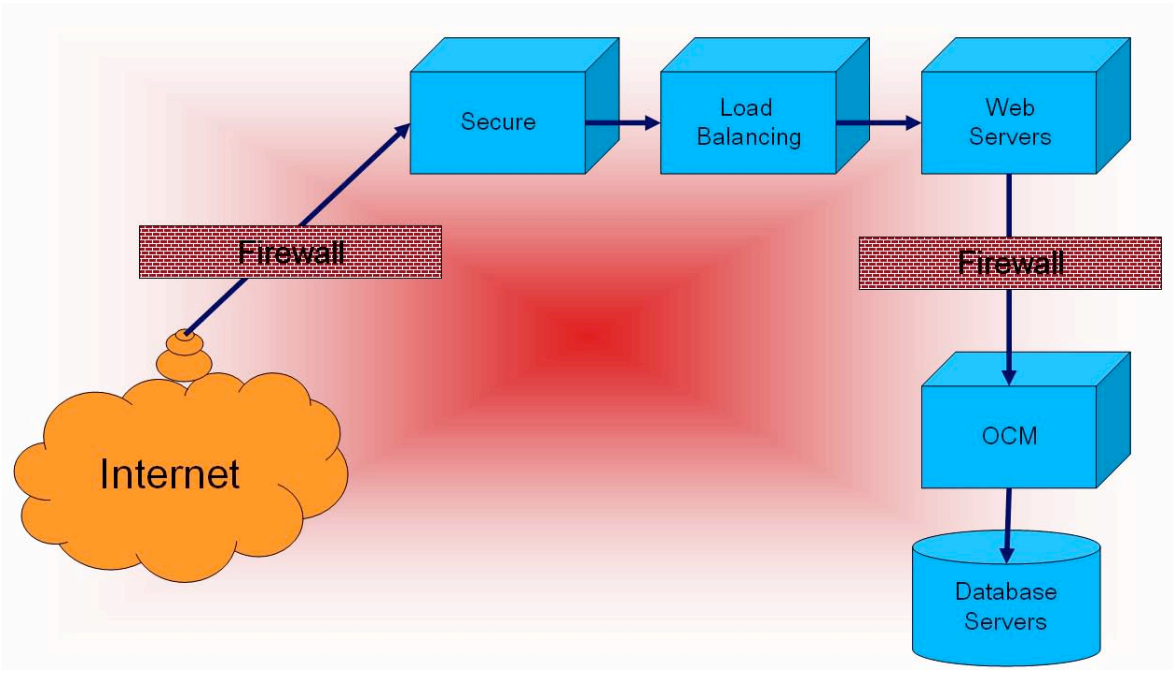
2.5.4 WEB portal for registration of BAS and other devices

All devices eligible for protection against TV band databases may register via the web portal. In order to prevent abuse in filing and ensure that all devices are accurately represented in the database, the FCC may want to consider requiring all unlicensed device users to first obtain an FCC registration number (FRN) through CORES before registering with the TV band database. Requiring an FRN when filing would help to prevent large-scale spamming that could negatively impact the database accuracy and performance.

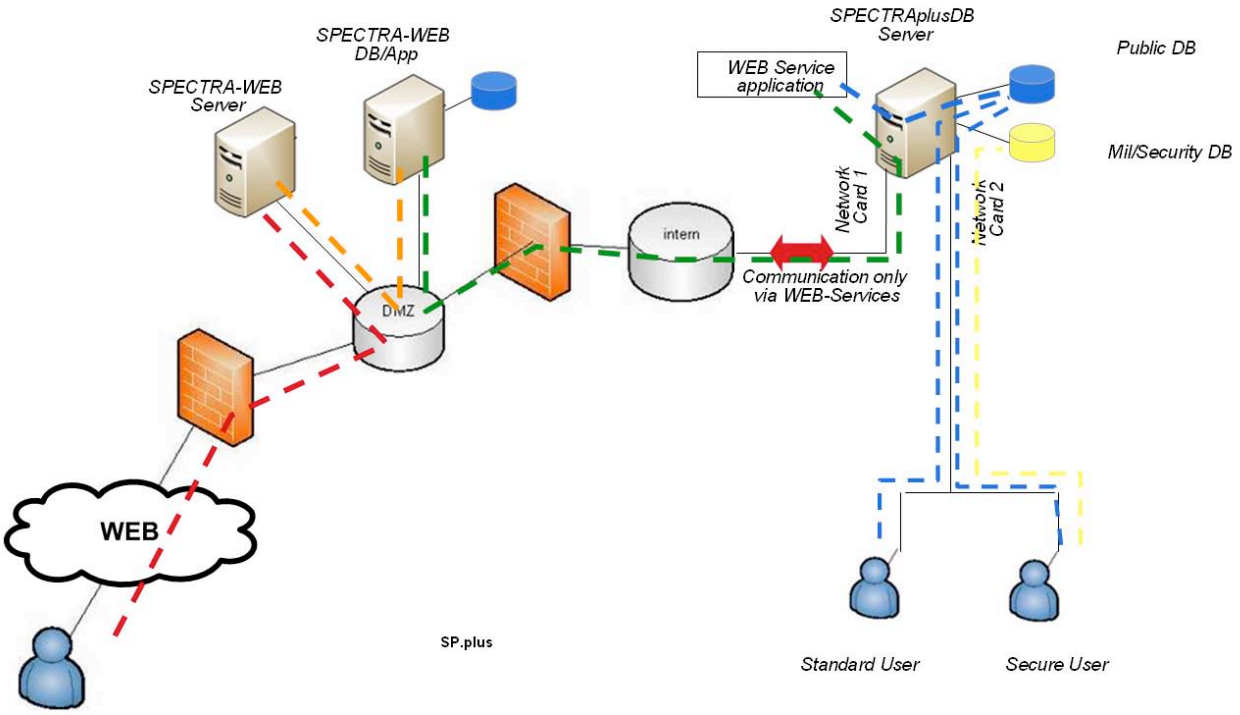
2.6 Database security

2.6.1 WEB security

The KBE/LS TV bands database will employ tested and secure methods to support device communication and verification with the database. The system will contain several Firewalls in order to protect the database content. Additionally, the communication between the Interfaces and the actual database will only operate via web services in order to avoid direct exposure to the internet. The following drawings show the basic construction of the interface and data streams between the outside world and the database.



General Structure of the Web interface protection.



Data streams from the outside world into the database.

2.6.2 Protection against data loss and server breakdown

The system is built with a redundant solution, using ORACLE Real Application Cluster (RAC) technology to ensure a permanent availability of the central database system. The Web servers also have redundancy components using load-balancing technology. The hardware itself has redundant power supplies and Hot-Plug Raid solutions for data storage.

In addition, the system includes a hot backup facility so that the database may be backed up while in operation. Backups of the database will be performed as differential backups every night and full backups once a week.